APPENDIX A

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Intraoperative electrooculographic monitoring of oculomotor nerve function during skull base surgery

Technical note

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Intraoperative monitoring techniques for protecting the integrity of the oculomotor nerves during skull base surgery have been reported by several investigators, all of which involved the use of electromyographic responses to extraocular muscles. However, these techniques have not yet become popular because of the complexity of the procedures. The authors report an extremely simple and far more reliable technique in which electrooculographic (EOG) monitoring is used. The oculomotor nerves were stimulated with a monopolar electrode during skull base exposure. The polarity of the EOG responses recorded with surface electrodes placed on the skin around the eyeball yielded precise information concerning the location and function of the oculomotor and abducent nerves. In addition, with the aid of continuous EOG monitoring that detected transient changes in the background waves, surgical procedures that might impinge on oculomotor nerve function could be avoided. The present technique has been used in eight patients with skull base tumors and with it, the authors have achieved excellent results.

KEY WORDS • oculomotor nerve • electrooculography • skull base surgery

INTRAOPERATIVE monitoring techniques for protecting the integrity of the oculomotor nerves during skull base surgery, all of which have involved the use of electromyographic (EMG) responses of extraocular muscles, have been described by several investigators.[1,2,4-6] However, these techniques have not so far been popularized because of their complexity. We have developed an extremely simple and far more reliable technique, which involves the use of electrooculographic (EOG) monitoring. This technique has been applied in eight patients with skull base tumors and has yielded excellent results. On the basis of our experience, we report details of our technique and discuss its value for preserving oculomotor nerve function during skull base surgery.

Intraoperative Technique

Anesthesia. Anesthesia was induced in the patient by intravenous administration of propofol. Muscle relaxants were given only to facilitate intubation. Generally, propofol was administered at a dose of approximately 10 mg/kg/hour during surgery and a bolus injection of 1 or 2 μg/kg of fentanyl was added on the basis of the patient's heart rate and blood pressure.

Stimulation Technique. A monopolar stimulator was used to stimulate the cranial nerves during surgery. The tip diameter of this stimulator is 0.75 mm, and it is made of malleable silver. The portion 7 cm from the head of the stimulator can be bent, as necessary, to allow the stimulator to reach a deep, narrow operative field.

Cathodal stimulation was performed through this electrode, and an anodal electrode was placed on frontozygomatic bone. Rectangular pulses of 0.2-msec duration were applied at a repetition rate of three times per second. The maximum stimulus intensity was 3 mA in the present study.

Recording Technique. Surface electrodes were placed on the skin around the eyeball. For Channel 1, the active electrode was placed on the right side and the reference electrode on the left side. For Channel 2, the active electrode was placed on the upper side of the eyeball and the reference electrode on the lower side. However, in four recent cases, we have used only the electrodes on the bilateral sides. In fact, based on our experience, two horizontal electrodes are sufficient to identify the oculomotor nerve and abducent nerve. Under these conditions, movements of the eyeball toward the right side induce a positive wave on the oscilloscope, whereas movements toward the left side induce a negative wave. The surface electrodes used here were not special in any way; ordinary electrodes can be used. In the present study, we applied surface electrodes that were identical to those used for electrocardiograms. The bandpass was established from 5 Hz to 3 kHz, and no signal processing was needed.

clusion, EOG monitoring appears to be a most useful technique for tracking the intraoperative oculomotor nerve function during skull base surgery.

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